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**N-Methyl Pyrrolidone:
Chemical Profile**

Technical Report No. 36

1996

University of Massachusetts Lowell



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N-Methyl Pyrrolidone: Chemical Profile

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1996



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The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to promote the reduction in the use of toxic chemicals or the generation of toxic chemical byproducts in industry and commerce. Further information can be obtained by writing the Toxics Use Reduction Institute, University of Massachusetts Lowell, One University Avenue, Lowell, Massachusetts 01854.

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Introduction

The Toxics Use Reduction Act (TURA) was passed in 1989 with the goal of reducing toxic chemical use and the generation of toxic byproducts in Massachusetts. Companies who use over a threshold amount of any reportable chemical are required to list the quantities of the chemicals used, quantity of byproduct generated, and other information on chemical use and emissions in their facility.

N-methyl pyrrolidone (NMP) was added to the Federal Toxics Release Inventory (TRI) and TURA list of reportable chemicals on November 30, 1994 for the 1995 reporting year. An Environmental Protection Agency (EPA) NMP-specific assessment (leading to its addition on the list) began in response to information indicating that exposure to NMP could present a significant risk of reproductive and developmental harm to humans. The *Final Assessment*¹ concludes that such a reproductive and developmental risk does exist.

Occupational exposure standards have not yet been established for NMP. There is currently no Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) or National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) for airborne exposure to NMP.

N-methyl pyrrolidone has been used in industry as a substitute for other undesirable solvents. In particular, it has been introduced as a less toxic and low volatility substitute for solvents such as methylene chloride and 1,1,1 trichloroethane, for applications such as paint removal, graffiti removal, cured urethane cleanup, and industrial degreasing.

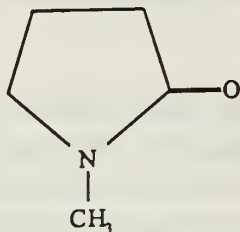
According to the EPA, although paint stripping accounts for only 10-15% of NMP used, it appears to offer the greatest potential for exposures because many of the other uses involve closed processes. Virtually all paint stripping chemicals and processes involve some form of health or safety risk.

The exposure path of most concern to individuals is the dermal route. Exposure to NMP by inhalation is also possible.

¹Office of Prevention, Pesticides, and Toxic Substances (OPPTS), Environmental Protection Agency (EPA), "Lifecycle Analysis and Pollution Prevention Assessment for N-Methyl Pyrrolidone (NMP) in Paint Stripping," September, 1993.

Table 1. Chemical and Physical Properties of N-methyl pyrrolidone

The chemical structure of NMP is:



CAS #: 872-50-4

Synonyms: N-methyl gamma butyrolactam, 1-methyl azacyclopentan-2-one, M-pyrol, N-methyl-2-pyrrolidone, N-methyl-alpha-pyrrolidinone, 1-methyl-2-pyrrolidone, NMP.

Molecular Formula: C₅H₉NO

Odor: Mild amine odor

Boiling Point: 396°F at 760mmHg

Melting Point: -11°F

Vapor Pressure: 0.3 mmHg at 68°F

Specific Gravity: 1.033 (H₂O = 1.0 at 39.2 °F)

Solubility in H₂O: Miscible.

VOC (gm/L): 806

Evaporation Rate: 1.300 (Butyl Acetate = 1)

Combustible: Yes

Autoignition Temperature: 518°F

Flash Point: 187-204°F

Toxicity: Threshold Limit Value (TLV) estimated at 100ppm

Chemical and Physical Properties

The chemical and physical properties of NMP summarized here are listed in Table 1 (a complete Material Safety Data Sheet (MSDS) can be found in Appendix A). N-methyl pyrrolidone is a colorless liquid with a mild amine odor. It is completely miscible in water and in most organic solvents, including alcohols, ethers, aromatics, and chlorinated hydrocarbons. It has a relatively low vapor pressure of 0.3 mmHg at 25°F, and therefore evaporates slowly. NMP's boiling point is 396°F at 760 mmHg and its freezing point is -11°F. NMP has a high flash point (187-204°F), and an autoignition temperature of 518°F.

N-Methyl Pyrrolidone In The Environment

N-methyl pyrrolidone may be a naturally occurring compound, as it has been identified as a volatile component of roasted nuts. It (NMP) may be released to the environment as a fugitive emission during its production, formulation or use. It may also be released to water from equipment cleaning and spill clean-up.

EPA release estimates presented in the Draft NMP RM2 Assessment (as referred to in the *Final Assessment*²), and estimates from the producers do not indicate that NMP poses any significant risk to the environment or to the general population. If released to the soil, NMP has the potential to biodegrade under aerobic conditions. If released to water, NMP will biodegrade under aerobic conditions after a short lag period. A calculated bioconcentration factor of 0.16 indicates that NMP is not expected to significantly bioconcentrate in fish and aquatic organisms, nor is it expected to significantly volatilize from water to the atmosphere.

Workers may be exposed to NMP during drumming and sampling activities and spill clean-up. Exposure may occur by dermal contact or inhalation during its production and use. General population exposures are expected to be minimal.

Health Hazards

Few studies have been conducted to assess the short and long term effects of human exposure to N-methyl-pyrrolidone. As stated previously, most occupational and consumer exposure to N-methyl pyrrolidone occurs by dermal contact or inhalation during its production and use.

²Office of Prevention, Pesticides, and Toxic Substances (OPPTS), Environmental Protection Agency (EPA), "Lifecycle Analysis and Pollution Prevention Assessment for N-Methyl Pyrrolidone (NMP) in Paint Stripping," September, 1993.

Exposure to NMP

The Environmental Protection Agency's main concern with NMP is the risk of chronic reproductive and developmental effects to consumers and workers in the commercial submarket using NMP-based strippers. Consumer exposures to NMP could occur while applying paint stripper to the surface to be stripped, and while scraping or otherwise removing the stripper and the stripped paint. Appropriate gloves are expected to be protective against the dermal contact risks for workers, however, in the absence of clear information on the hazard, and a description of proper glove use and disposal, consumers are very likely to be exposed to NMP in paint strippers.

The risk of reproductive and developmental effects is expressed as a Margin of Exposure (MOE). The MOE is the No Observed Adverse Effect Level (NOAEL) or the Lowest Observed Adverse Effect Level (LOAEL) of the critical toxic effect divided by the estimated exposure level (EEL). MOEs above 100 imply no human effects if derived using a NOAEL. If derived from a LOAEL, an MOE above 1,000 is considered protective. Without gloves, production worker MOEs for reproductive effects from dermal exposure range from 0.9 to 2.7 (compared to a protective MOE of 1,000 for a LOAEL), and from 2.9 to 8.6 compared to a protective MOE of 100 for a NOAEL. The Margins of Exposure for developmental effects are higher, but are also not protective.

Due to the low vapor pressure of NMP, the estimated MOEs for reproductive and developmental effects from inhalation exposure are at protective levels.

Effects of Exposure to NMP

Based on tests with laboratory animals, overexposure to NMP may cause reproductive disorders in organs such as the bone marrow, thymus, spleen, and in the lymphatic system. Reproductive and developmental studies in animals exposed to NMP showed reduced fertility and reduced mean offspring body weight at birth and throughout lactation.³ The "rabbit gavage developmental toxicity study" demonstrated significant reduction in mean body weight gain after exposure to doses as low as 175mg/day. Slightly increased doses (540mg/day) resulted in misshapen skull bones and cardiovascular malformations.

In addition, the two generation study by Exxon Biomedical in 1991³ provided evidence of systemic toxicity after exposure to 500mg/kg. Exposure to 50mg/kg or more resulted in serious reductions in the male fertility index and the female fecundity index. These effects in animals suggest that similar effects may occur in humans, and support the decision to list NMP.

Inhalation studies by the National Institute for Occupational Safety and Health (NIOSH) with laboratory animals showed that rats exposed to a concentration of 1 milligram per liter (246 parts per million [ppm]) for 6 hours a day for 4 weeks experienced lethargy, difficulty breathing, and increased mortality. No carcinogenic or life shortening effects were observed in a 2-year study

³Office of Prevention, Pesticides, and Toxic Substances (OPPTS), Environmental Protection Agency (EPA), "Lifecycle Analysis and Pollution Prevention Assessment for N-Methyl Pyrrolidone (NMP) in Paint Stripping," September, 1993.

of rats injected with 0.04mg/L and 0.4mg/L of N-methyl pyrrolidone. Even though inhalation effects are unlikely due to the low vapor pressure of NMP, if operators use heat or perform stripping with NMP in poorly ventilated areas, the risk of reproductive and developmental effects from inhalation exposure may increase.

NMP may cause severe dermatitis upon prolonged or repeated contact⁴. In particular, prolonged skin contact can cause redness, swelling, and cracking. An investigation conducted at an electrotechnical company in Norway⁵ showed that workers experienced severe irritant reactions of the skin after a few days of work with the solvent. After 2 days of work with NMP, 10 of the 12 workers involved displayed acute irritant contact dermatitis of the hands.

A recent study of NMP use in the microelectronics industry indicates that severe eye irritation and headaches are expected at levels as low as 0.7ppm in air for periods as short as 30 minutes. NMP is regarded as a severe eye irritant because it has produced corneal opacity and conjunctivitis in rabbits.

Method of Manufacture and Uses

N-methyl pyrrolidone is manufactured mainly by condensing butyrolactone with methylamine (see equation below). It may also be made by high pressure synthesis from acetylene and formaldehyde.



Separation of the water and NMP is generally achieved by distillation. NMP is commonly used in the pure state, but can also be blended for special applications with various surfactants and thickeners. The major uses of NMP are as follows:

- In commercial processes to strip paint. NMP removes paint more slowly than methylene chloride, but NMP dissolves multiple layers rather than lifting each coat.
- In the electronics industry for cleaning and degreasing single-crystal silicon wafers for integrated circuits. NMP is also an active ingredient in a commercially available semiaqueous cleaner used to deflux printed wiring boards (PWBs).
- Large scale recovery of hydrocarbons and aromatics by extractive distillation.
- In immersion and ultrasonic equipment to clean engine parts (oil and carbon deposits), remove printing ink residues, and remove temporary coatings from optical components.
- NMP is used as a solvent for surface coatings, including acrylates, polyurethanes, polyvinylchlorides, water based coatings, and printing inks.

⁴[Http://www.clean.rti.org](http://www.clean.rti.org)

⁵Leira, Hakon L., Tiltne, A., Svendsen, K., Vetlesen, L., "Irritant Cutaneous Reactions to N-methyl-2-pyrrolidone (NMP)," *Contact Dermatitis*, Vol.27, 1992.

Exposure Standards and Regulations

NMP is on the list of chemicals that must be reported under the Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III, Section 311/312, hazard categories, as an intermediate (acute) health hazard, fire hazard, and delayed (chronic) health hazard. It was also added to EPA's SARA 313 Title III, Section 313 list on August 1, 1996.

The NMP Producers group (including ARCO Chemical Company, ISP, and BASF), as well as the Chemical Manufacturer's Association (CMA) have appealed the decision to list NMP on SARA 313. A ruling on this appeal is likely to occur in 1997. Before that ruling however, SARA 313 reporting will be required by facilities manufacturing or processing 25,000 pounds or otherwise using 10,000 pounds per year.

The Environmental Protection Agency has concluded that NMP does not meet the requirements for listing for acute environmental effects, and that the likelihood of the general population being exposed to NMP is not significant. However, because NMP is a potential reproductive and developmental toxicant, EPA believes that in the event of any release of NMP to the environment, the public should be informed.

In 1985, NMP was approved by EPA for use as an inert ingredient in pesticide formulation. It is thus exempt from the requirement of a Federal Food, Drug, and Cosmetic Act (FFDCA) section 408 tolerance. NMP is permitted to be used in the preparation of slimicides used in the manufacture of paperboard that contacts food (21 CFR 176.300(d)).

As stated previously, occupational exposure standards have not yet been established for NMP. There is currently no OSHA permissible exposure limit (PEL) or NIOSH REL for airborne exposure to NMP.

M-PYROL**SECTION 01 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION****DOMESTIC TRADE NAME: M-PYROL****EXPORT TRADE NAME: M-PYROL****CAS REGISTRY NO.: 00000872-50-4****CAS REGISTRY NAME: 2-PYRROLIDINONE, 1-METHYL-
SYNONYM: N-METHYLPYRROLIDONE****MOLECULAR FORMULA: C₅H₉NO****MOLECULAR WEIGHT: 99.00****SECTION 02 - COMPOSITION/INFORMATION ON HAZARDOUS INGREDIENTS****CAS REGISTRY NUMBER: 00000872-50-4****CAS REGISTRY NAME: 1-METHYL-2-PYRROLIDINONE****COMMON NAME: N-METHYLPYRROLIDONE (NMP)****HAZARD%: MINIMUM 99.80****HAZARD REFERENCE:****ISP RECOMMENDED EXPOSURE LIMIT: 100 PPM****SUBJECT TO REPORTING UNDER SARA SEC. 313****SECTION 03 - HAZARDS IDENTIFICATION**

***** EMERGENCY OVERVIEW *****
*
* CLEAR LIQUID WITH MILD AMINE-LIKE ODOR. *
* COMBUSTIBLE LIQUID IN U.S.A. ONLY. *
* CAUSES EYE IRRITATION. *
* PROLONGED OR REPEATED EXPOSURE CAUSES SEVERE SKIN IRRITATION. *
*

-ACUTE TOXICITY-**ORAL TOXICITY:****RAT LD50: 4200 MG/KG****DERMAL TOXICITY:****RABBIT LD50: 8000 MG/KG**

SECTION 03 - HAZARDS IDENTIFICATION (CONT.)

INHALATION TOXICITY:

RAT; AT SUPER SATURATED (110 DEG. C.) CONCENTRATIONS;
NO EVIDENCE OF TOXIC EFFECTS.

SKIN IRRITATION:

MILD IRRITATION IN THE RABBIT; HOWEVER, HUMAN EXPERIENCE HAS
DEMONSTRATED SEVERE DERMATITIS, e.g. BLISTERS, CRACKING, EDEMA,
REDNESS UPON PROLONGED OR REPEATED CONTACT.

EYE IRRITATION:

RABBIT; 100% MATERIAL; MODERATE IRRITANT, NO PERMANENT DAMAGE.

SENSITIZER:

HUMAN REPEAT INSULT PATCH TEST; MILD, TRANSIENT IRRITATION THROUGH
REPEATED, PROLONGED CONTACT; MATERIAL WAS FOUND TO BE A FATIGUING AGENT
BUT NOT A SENSITIZER.

DOT CORROSIVE:

NO DATA FOUND

PRIMARY ROUTE(S) OF ENTRY: ABSORPTION / CONTACT

-SIGNS AND SYMPTOMS OF EXPOSURE-**SYMPTOMS OF INGESTION:**

NO EFFECTS OF EXPOSURE EXPECTED.

SYMPTOMS OF INHALATION:

NO EFFECTS OF EXPOSURE EXPECTED. IF MISTED OR AT HIGH CONCENTRATIONS,
MAY CAUSE PALLOR, NAUSEA, ANESTHETIC OR NARCOTIC EFFECTS.

SYMPTOMS OF SKIN CONTACT:

PROLONGED OR REPEATED CONTACT CAUSES REDNESS, SWELLING, CRACKING.

SYMPTOMS OF EYE CONTACT:

VAPORS SLIGHTLY UNCOMFORTABLE. SPLASHES IRRITATING. WILL CAUSE PAINFUL
BURNING OR STINGING OF EYES AND LIDS, WATERING OF EYES AND INFLAMMATION
OF CONJUNCTIVA.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

NO DATA FOUND

-OTHER TOXICITY-**OTHER ACUTE TOXICITY:**

NO DATA FOUND

SECTION 03 - HAZARDS IDENTIFICATION (CONT.)

SUB CHRONIC ORAL TOXICITY:

90-DAY FEEDING STUDIES IN MICE, RATS AND DOGS, IN CONCENTRATIONS UP TO 1% OF THE DIET, FAILED TO DEMONSTRATE ANY TREATMENT RELATED EFFECTS.

SUB CHRONIC INHALATION TOXICITY:

INHALATION STUDIES; RATS, GUINEA PIGS, RABBITS, CATS; NO GROSS OR HISTOPATHOLOGICAL ABNORMALITIES WHEN EXPOSED TO 50 PPM NMP FOR 8 HOURS/DAY FOR 20 DAYS; EXPOSURES AS HIGH AS 370 PPM FOR 6 HOURS/DAY FOR 10 DAYS SIMILARLY CAUSED NO EFFECTS IN RATS.

4-WEEK; RAT; AEROSOL-VAPOR MIXTURE OF NMP AT 0, 0.1 (25 PPM), 0.5 (123 PPM) AND 1.0 (247 PPM) MG/L FOR 6 HOURS/DAY, 5 DAYS/WEEK; NO EFFECTS AT 0.1 OR 0.5 MG/L; HEMOPOIETIC (BLOOD SYSTEM) EFFECTS OBSERVED AT 1.0 MG/L.

SUB CHRONIC MISCELLANEOUS TOXICITY:

20-DAY DERMAL; RABBIT; 0.4, 0.8 AND 1.6 ML/KG/DAY ON ABRADED AND INTACT SKIN; MILD LOCAL IRRITATION; NO SYSTEMIC EFFECTS; 1/4 ANIMALS DIED AT 1.6 ML/KG/DAY.

AQUATIC TOXICITY:

BLUEGILL (LEPOMIS MACROCHIRUS) LC50 (AT 22 DEG. C): 832 MG/L;
FATHEAD MINNOW (PIMEPHALES PROMELAS) LC50 (AT 22 DEG. C): 1072 MG/L;
TROUT (SALMO GAIIRDNERI) LC50 (AT 12 DEG. C): 3048 MG/L.

TUMORIGENICITY:

2-YEAR; RAT; VAPOR OF NMP AT 0, 0.04 (10 PPM) AND 0.4 (99 PPM) MG/L FOR 6 HOURS/DAY, 5 DAYS/WEEK; NO LIFE-SHORTENING TOXIC OR CARCINOGENIC EFFECTS OBSERVED.

MUTAGENICITY:

NMP WAS TESTED IN THE AMES ASSAY, CHO/HGPRT FORWARD MUTATION ASSAY, MOUSE LYMPHOMA ASSAY, RAT PRIMARY HEPATOCYTE UDS ASSAY, DOMINANT LETHAL ASSAY AND MOUSE MICRONUCLEUS TEST. IN EACH CASE, NMP WAS FOUND TO BE NONMUTAGENIC.

REPRODUCTIVE TOXICITY:

RAT; DERMAL; DEVELOPMENTAL TOXICITY; 75, 237 AND 750 MG/KG; MATERNAL AND DEVELOPMENTAL NOEL (NO OBSERVED ADVERSE EFFECT LEVEL): 237 MG/KG.
RAT; INHALATION; DEVELOPMENTAL TOXICITY; 0.1 (25 PPM) AND 0.36 (89 PPM) MG/L; MATERNAL AND DEVELOPMENTAL NOEL: 0.36 (89 PPM) MG/L.
RABBIT; ORAL; DEVELOPMENTAL TOXICITY; 55, 175 AND 540 MG/KG/DAY; MATERNAL NOEL: 55 MG/KG/DAY; DEVELOPMENTAL NOEL: 175 MG/KG/DAY.
RAT; ORAL; MULTI-GENERATION; 50, 160 AND 500 MG/KG/DAY; PARENTAL, REPRODUCTIVE AND DEVELOPMENTAL NOEL: 160 MG/KG/DAY.

MISCELLANEOUS TOXICITY:

NO DATA FOUND

SECTION 04 - FIRST AID MEASURES

FIRST AID FOR INGESTION:

GENERAL PRECAUTIONARY MEASURES SUGGEST INDUCING VOMITING IMMEDIATELY BY GIVING TWO GLASSES OF WATER AND STICKING FINGER DOWN THROAT. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. CALL A PHYSICIAN.

FIRST AID FOR INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

FIRST AID FOR SKIN CONTACT:

WASH SKIN WITH SOAP AND WATER. CALL A PHYSICIAN. WASH CLOTHING BEFORE REUSE.

FIRST AID FOR EYE CONTACT:

IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN.

SECTION 05 - FIREFIGHTING MEASURES

FLASH POINT: 199.00 DEG F (CC)

AUTOIGNITION TEMP: 518.00 DEG F

FLAMMABLE LIMITS: 1.30% - 9.50%

FIRE FIGHTING MEDIA: WATER / ALCOHOL FOAM / DRY CHEMICAL / CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:

FIREFIGHTERS SHOULD WEAR POSITIVE PRESSURE, FULL FACE SELF-CONTAINED BREATHING APPARATUS. COOL FIRE-EXPOSED CONTAINERS WITH WATER SPRAY.

CAUTION: AFTER FIRE IS EXTINGUISHED, MATERIAL VAPORS COULD ACCUMULATE, TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK.

FIRE/EXPLOSION HAZARDS:

COMBUSTIBLE LIQUID. FIRE HAZARD WHEN EXPOSED TO HEAT, SPARKS OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK. VAPOR-AIR MIXTURES ARE EXPLOSIVE.

NFPA HAZARD CODES - HEALTH/FLAMMABILITY/REACTIVITY 2 2 0

HMIS HAZARD CODES - HEALTH/FLAMMABILITY/REACTIVITY 2 2 0

SECTION 06 - ACCIDENTAL RELEASE MEASURES

SPILL/LEAK CLEAN-UP PROCEDURES:

ELIMINATE SOURCES OF IGNITION. ABSORB WITH EARTH, SAND OR SIMILAR INERT MATERIAL AND DISPOSE OF WITH SOLID WASTE ACCORDING TO FEDERAL, STATE AND LOCAL REGULATIONS. FLUSH SPILL AREA WITH A WATER SPRAY.

EPA HAZARDOUS SUBSTANCE REPORTABLE QUANTITY: NOT LISTED

SECTION 07 - HANDLING AND STORAGE

PRECAUTIONARY MEASURES:

AVOID CONTACT WITH EYES, SKIN AND CLOTHING. WASH THOROUGHLY AFTER HANDLING. AT HIGH CONCENTRATIONS, USE WITH ADEQUATE VENTILATION. KEEP CONTAINER AND VAPORS FROM THIS CONTAINER AWAY FROM HEAT, SPARKS AND FLAME. KEEP CONTAINER CLOSED.

DISPOSAL METHOD:

DISPOSE OF WITH LIQUID WASTE ACCORDING TO FEDERAL, STATE AND LOCAL REGULATIONS.

RCRA CLASS: NOT REGULATED

SECTION 08 - EXPOSURE CONTROLS/PERSONAL PROTECTION

VENTILATION:

AT HIGH CONCENTRATIONS, USE WITH ADEQUATE VENTILATION.

RESPIRATORY PROTECTION:

NIOSH-APPROVED RESPIRATOR, WHERE TLV OR PEL MAY BE EXCEEDED.

EYE PROTECTION:

CHEMICAL GOGGLES.

SKIN PROTECTION:

IMPERVIOUS GLOVES OF NATURAL LATEX OR NEOPRENE (SPECIFICALLY, NATURAL LATEX GLOVES AR-340 AND STYLE #Y-18 FROM GLOVER LATEX INC. - ANAHEIM, CA; OR A NEOPRENE GLOVE "SCORPIO" #8-352 FROM EDMONT WILSON - COSHOCTON, OH).

PERSONAL HYGIENE:

WASH THOROUGHLY AFTER HANDLING.

PROTECTIVE MEASURES DURING REPAIR/MAINTENANCE OF EQUIPMENT:

WASH EQUIPMENT THOROUGHLY WITH STEAM OR WARM WATER UNTIL CLEAN. CHECK FOR FLAMMABLES WITH AN 'EXPLOSION METER' AND ALSO CHECK THE OXYGEN LEVEL WITH AN OXYGEN METER. IN ALL CASES, FOLLOW GOOD INDUSTRIAL SAFETY PRACTICES BEFORE ENTERING EQUIPMENT.

SECTION 08 - EXPOSURE CONTROLS/PERSONAL PROTECTION (CONT.)

EXPOSURE LIMITS:

SEE SECTION 02 FOR COMPOSITION/INFORMATION ON HAZARDOUS INGREDIENTS.

SECTION 09 - PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT: 202.00 DEG C

VAPOR PRESSURE: 0.29 mm Hg (AT 20 DEG. C)

VAPOR DENSITY (AIR=1): 3.40

WATER SOLUBILITY: MISCIBLE

MELTING/FREEZING POINT: -24.40 DEG C

APPEARANCE: CLEAR LIQUID

SPECIFIC GRAV. (WATER=1): 1.025 - 1.035 (25 DEG. C)

PERCENTAGE VOLATILES: NONVOLATILE AT S.T.P.

EVAPORATION RATE: 0.03 (BUTYL ACETATE = 1)

pH OF SOLUTION: 7.20 APPROXIMATELY (10% SOLUTION)

ODOR: MILD, AMINE-LIKE ODOR

BIODEGRADABILITY: WARBURG RESPIROMETRY METHOD; BIODEGRADABLE.

SECTION 10 - STABILITY AND REACTIVITY

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID:

NONE KNOWN

INCOMPATIBLE MATERIALS:

STRONG OXIDIZING OR REDUCING AGENTS.

HAZARDOUS DECOMPOSITION PRODUCTS:

CO AND NO_x FUMES EMITTED WHEN HEATED TO DECOMPOSITION.

SECTION 11 - TRANSPORT INFORMATION

-DOMESTIC DATA-

DOT SHIPPING NAME: COMBUSTIBLE LIQUID, N.O.S. (ONLY IN BULK; > 119 GAL.)

DOT HAZARD CLASS: COMBUSTIBLE LIQUID (IN BULK)

HAZARDOUS INGREDIENT(S): (CONTAINS N-METHYL-2-PYRROLIDONE)

UN NUMBER: NONE

NA NUMBER: 1993

SECTION 11 - TRANSPORT INFORMATION (CONT.)

-EXPORT DATA-

EXPORT SHIPPING NAME: NOT REGULATED

EXPORT HAZARD CLASS: NOT REGULATED

HAZARDOUS INGREDIENT(S): NONE

UN NUMBER: NONE

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